TECHNICAL NOTES

NATURAL RESOURCES CONSERVATION SERVICE – WYOMING

AGRONOMY NO. 18 **June 13, 2001/February 2007**

SUBJECT: Soil Conditioning Index (SCI) and STIR (RUSLE2 cancels WY-ECS-28, 47)

INTRODUCTION

One area of growing concern in the agriculture industry is degradation of soil quality through processes that are influenced by management, including the decline of organic matter. A combination of effects can cause degradation of "soil condition". Wind and water erosion remove fine soil particles, organic matter, and plant nutrients, reducing productivity and the ability of the soil to hold water. Excessive tillage can accelerate erosion, mineralize organic matter and cause soil compaction. Crop rotations which produce low amounts of residue, and/or which involve extensive residue removal, result in inadequate amounts of organic material returned to the soil. The Revised Universal Soil Loss Equation Version 2 (RUSLE2) is the official NRCS tool to measure the SCI and STIR (Soil Tillage Intensity Rating). The RUSLE2 "Profile" report is the format used to evaluate calculations.

The Soil Conditioning Index tool, now located in the RUSLE2 water erosion program, predicts the effects of management systems on soil organic matter. Soil organic matter level is the primary indicator of soil condition. It affects soil characteristics and processes such as cation exchange capacity, aggregate stability, water holding capacity, and soil biological activity. Soil condition is the degree to which a soil maintains the ability to accept, store and release water, nutrients, and energy, to promote and sustain root growth, soil biological and chemical processes, resist erosion, compaction, and other management impacts.

The important components of the Index (SCI) include

- The amount of organic material returned to the soil,
- The effects of tillage and planting systems on organic matter decomposition, and
- The effect of predicted erosion associated with management systems

The Index predicts organic matter change qualitatively, not quantitatively. It predicts one of three outcomes organic matter decline, organic matter increase, or organic matter equilibrium. The index considers organic material (biomass) produced and returned to the soil, the influence of climate on organic matter decay, the influence of tillage, and the influence of erosion.

Components of the Soil Conditioning Index

The Soil Conditioning Index is:

SCI = OM + FO + ER

where:

SCI is the Soil Conditioning Index. The Soil conditioning Index estimates the combined effect of the three variables on trends in soil organic matter. Soil organic matter trends are assumed to be an indicator of improvement or degradation of soil condition.

OM is organic material. This component accounts for the effect of organic material returned to the soil. Organic material from plant or animal sources may be either grown or retained on site or imported to the site.

FO is field operations. This component accounts for the effect of field operations (tillage) that stimulate organic matter breakdown. Tillage, planting, fertilizer application, spraying and harvesting crush and shatter plant residues and aerate or compact the soil. These effects increase the rate of residue decomposition and affect the placement of organic material in the soil profile.

ER is erosion. This component accounts for the effect of removal or sorting, or both, of surface soil material by the sheet, rill, wind, or irrigation-induced erosion processes that are predicted by erosion models. It does NOT account for the effect of concentrated flow erosion such as ephemeral or classic gullies. Erosion contributes to loss of organic matter and decline in long-term productivity. RUSLE2 SCI includes the most current Wind Erosion tool calculation of T. RUSLE2 will be able to include an irrigation-induced erosion value once a model is developed.

The value = 0 is assigned for conditions at assumed equilibrium (soil organic matter maintained, neither increasing nor decreasing). Conditions that tend to decrease soil organic matter compared to the benchmark conditions are assigned negative values; those that tend to increase soil organic matter compared to the benchmark condition are assigned positive values.

If the SCI value is negative, soil organic matter is predicted to be decreasing, and measures that enhance soil conditions should be planned. If the SCI value is zero or positive, soil organic matter is predicted to be stable or increasing.

RUSLE2 "worksheet" report format displays the calculations to evaluate different alternative systems:
To formulate alternatives, plan changes in the cropping management system that will address negative subfactor values. For example if the SCI value is less than zero:

- *Plan for additional high residue crops in the rotation such as alfalfa or small grains.
  *Plan for an additional year or two of high residue crops in the crop rotation.
- *Plan changes in the tillage/planting system to reduce the number and/or severity of tillage.
  *Limit fall tillage and/or consider reducing the preplant operations in your crop rotation.
- *Consider supporting practices such as cover crops, strip cropping, etc...
  *Limit residue removal by over-grazing or baling of crop residues.

RUSLE2 will also determine the Soil Tillage Intensity Rating (STIR). This measure is the soil disturbance based on tillage operations. It utilizes the speed, depth, surface distrubance percent and tillage type parameters to calculate a tillage intensity rating for the system used in growing a crop or a crop rotation. STIR ratings tend to show the differences in the degree of soil disturbance between systems. The kind, severity and number of ground disturbing passes are evaluated for the entire cropping rotation. A recommended speed is 5 mph.

Example of how various tillage implements disturb existing organic matter:
Chisel plow: Tillage intensity factor 75%; tillage depth 7"; ridge height 3"; flattens 25% corn residue,
(Straight points) 40% wheat residue; burys 58% corn residue, 68% wheat residue

Field Cultivator: Tillage intensity factor 40%; tillage depth 4"; ridge height 2"; flattens 30% corn residue,
(6-12" sweeps) 40% wheat residue; burys 30% corn residue, 35% wheat residue

Offset Disk: Tillage intensity factor 100%; tillage depth 6"; ridge height 4"; flattens 80% corn residue,
(Heavy) 90% wheat residue; burys 80% corn residue, 90% wheat residue

Moldboard Plow: Tillage intensity factor 100%; tillage depth 8"; ridge height 1"; flattens 100% corn residue,
100% wheat residue; burys 99% corn residue, 99% wheat residue